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ABSTRACT

This chapter reports the responses from eight colleges and universities in the United Kingdom to an international questionnaire as part of a study to investigate the initiation and development of computer facilities in education. Data are presented under the headings: general development and scale of work, purposes of the project or unit, training of non-specialists and consultancy services, courseware development, and expectations of computer based learning. (VT)

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EN ONTWIKKELING
VAN ONDERWIJS

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C.A. Hawkins

computer based learning 2

computer ondersteund onderwijs

1 U.K.-Groot-Brittannië

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a survey of the factors influencing its initiation and development

een onderzoek naar de factoren die de invoering en ontwikkeling van COO
beïnvloeden

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Chapter I COMPUTER BASED LEARNING IN U.K.

List of responding projects (8)

University of Leeds
Computer Based Learning Project
J.R. Hartley

University of Leeds
Computer Assisted Learning in Chemistry
P.B. Ayscough

Queen Mary College
University of London
Computer Assisted Learning in Engineering Sciences
(plus multi-institutional project)
P.R. Smith

University of Surrey
Computational Physics Teaching Laboratory
D. Jackson

University of Glasgow
- Clinical Decision Making
- Basic Mathematics at undergraduate level
W. Dunn

Napier College of Commerce and Technology
Further Education Service Mathematics
D. Leach

University of Edinburgh
Dept of Artificial Intelligence
J. Howe

University College London
Computers in the Undergraduate Science Curriculum
J. McKenzie

I. GENERAL DEVELOPMENT AND SCALE OF WORK

U.K. Table 1 , Base of operations

	<u>numbers of projects</u>
(1) academic faculty	6
(2) computer centre	2
(3) committee	6

(ESP (Engineering Sciences Project) in (1) and (3); 11 engineering departments in 9 institutions + central committee; Leeds (Hartley) project administratively in computer centre but practically in psychology department, independent machine, staff and budget)

None of the U.K. projects is hosted by a university education department.

Two (Hartley's project at Leeds, an experimental environment for a range of computer based learning activities; Howe's at Edinburgh, Artificial Intelligence) are in psychology departments.

The rest are in subject departments, predominantly in science or engineering.

Most are subject to formal committees; to a faculty board, or direct to university Senate and/or NDPCAL.

U.K. Table 2 , Main stimulus to establish unit

Source :	administrative	staff initiative	other
	NDPCAL significant for 2	7 mostly university subject depts , plus, of these 7, 2 acknowledge NDPCAL support 3 acknowledge compu- ter knowledge support 2 cite initiatives from 'cognitive science'	1 - slight pressure from general modernization 1 - problems in service maths courses

U.K. Table 3 , Main sources of innovative effort

	number of projects	comment
administration	2	
committee	2	(NDPCAL) (1 reports also faculty subjects depts.)
faculty group		
computer (1)	3	
education (2)	2	(both also reported in computer dept)
subject depts (3)	11	(1 also in computer and subject dept)
individual	1	interest in epistemology

Of those perceiving the main source of innovative effort from administration, one as assistant principal of a technical college was himself responsible for it. The other respondent shared the credit with the faculty group concerned.

There are some interfaculty groups, so there are some multiple responses in this column.

It will be noted that few report initiatives from either computer or education departments.

The subject departments sited in faculty group section (3) are predominantly maths, science, engineering and medicine.

U.K. Table 4 , Staffing

	number of personnel, totalled over all projects
educational psychologists	4
educatorists	13
computer scientists	29
lecturers (university level subject matter specialists)	150
students/ graduate assistants	13

1. Educational psychology

One respondent cites the additional support from the Assistant Director (Education) of NDPCAL, and the concurrent evaluation unit UNCAL.

The Leeds chemistry project acknowledges support from Leeds CELP project in psychology for columns (1) and (2).

2. Educationists

Most are described as educational technologists. Surrey project refers to Prof. Elton's Institute of Educational Technology.

Also in this column are listed teachers, one remedial and 2 educational technologists with interest in particular subject areas (maths and science).

3. Computer technologists

These are equally divided between systems analysts and programmers. One multi-institutional project reports the part-time involvement of three directors of computer services.

4. Lecturers

Mainly from maths, science and engineering.

few psychologists

one law

one management

one geography

one applied science (from the leather industry)

(Totals are presented here as reported, but probably, few are working full time in CAI, and will at least have teaching responsibilities, possibly additional research.)

5. Students and graduate assistants

Several of these combine subject matter and educational interest.

one chemical education

two maths education / media

three are computer scientists, one on employment period of sandwich course

two psychologists

two undertake routine tasks of documentation, illustration.

U.K. Table 5 , Direction of Projects

Size of committees

0 - 4	members	1
5 - 9	"	2
10 - 14	"	3
15 - 20	"	3

One project has no directing committee (Artificial Intelligence, Edinburgh). It is directed by the Project Leader.

Representation on directing committees

1. Administrators

Director (or representative) from NDPCAL	7 projects
Project Directors	specifically mentioned by only 3 projects (may be subsumed under "department heads")
University Registry	1 project
Scottish Education Dept.	2 projects
Faculty Dean (Science)	1 project
Assistant Principal	1 project

2. Heads of Departments

7 projects report representation of Head of Teaching Department
(science, engineering and maths)

3. Computer Scientists

3 projects indicate representation of computer scientists.
For 1 project, the chairman of the directing committee is a computer
scientist.

4. Computer Services

1 multi-institutional project reports NDPCAL representation
1 project reports co-option of computer services personnel when
necessary.

5. Educationists

1 project (CBLP at Leeds) includes 2 educationists on the directing
committee - the Head of Psychology
- the Chairman of the Centre for Studies in Science
Education.

6. Educational Technologists

2 projects (1 multi-institutional) report representation of independent
evaluation from UNCAL.
1 project reports representation from AVA (Audio Visual Aids).

7. University teachers (other than heads of dept)

3 projects (all maths, science or engineering)

8. Other

Several NDPCAL projects include the external financial evaluator
from Messrs Peat, Marwick on their directing committees.

1 Medical project includes representation from a parallel Medical
project in another university.
The two Scottish Maths projects (Dunn at Glasgow, Leach at Edinburgh)
are represented on each other's directing committees.
One Scottish project has representatives from SCOTBEC and SCOTEC.

U.K. Table 6 , Main types of resistance

Cost	3 projects - 2 of which state "slight but not excessive"
Lack of knowledge, lack of confidence	6 projects listed these jointly as a major problem. One of these referred to confusion between CAL and CAI as a problem. Lack of understanding of other aspects of innovation were also cited - - lack of appreciation of the role of a 'maths lab' - lack of concern for non-specialist students with learning difficulties.
Inertia	5 projects listed this as a major problem. One stated it was "felt but difficult to identify precisely".
Lack of time for reconstructing courses	5 projects One referred to the particular difficulty of getting initial specifications for teaching packages.
Lack of time for learning techniques	2 projects. One project stated "only <u>some</u> teaching staff".
Other	CBLP project at Leeds reports no problems. Grants have been obtained in competition with other proposals, but CBLP has always enjoyed strong support. Artificial Intelligence at Edinburgh reports main problem as funding, because their research project leads to theory building rather than immediate practical applications.

U.K. Table 7 , Main sources of resistance

Costs, and the higher priority of other projects	6 projects One project leader states - 'the project <u>is</u> high cost, costs have to be minimized and justified to colleagues'. 3 projects cite ' <u>competing financial requirements for research equipment</u> ' (i.e. scientific research, which contrasts with the following)
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	1 project - Artificial Intelligence Edinburgh - regrets that - 'in an atmosphere of general shortage of funds, there is an emphasis on quick pay-offs'.
Other pressures on teachers	3 projects 2 specifically cite scientific research

One project, CBLP Leeds, reports no resistance. "Universities are large, and interested parties can always be found. Problem areas have always been identified where there is a clear contribution from computers".

U.K. Table 8 , Obstacles to teacher cooperation

Learning a computer language	none found this important
Learning to construct a self-instructional package	1 - referred to lack of confidence here 1 - slight problem 2 projects had resources to meet this
Incentives	4 rated this important of which 1 specifically noted lack of publication outlet
No training or follow up to training	not considered a problem
Other issues	- the active staff members, likely to innovate, have little time - the CAI case is at present weak - the general shortage of computing facilities, funds and support staff

U.K. Table 9 , Transfer

	Use of materials from other projects, before own courseware was developed
Yes	1
Limited	3
No	4
None available	1

Problems

- documentation
- some materials said to be CAL were still in development
- materials available didn't fit the course
- technical problems

U.K. Table 10 , Use of own materials elsewhere

All comments made can be subsumed under the following two headings.

1. How much adaptation was needed?

Technical problems to be overcome

- Main difficulties in the computer system (presumably other than in transferring materials also space, whether interactive, response time, etc.)
- No problem when same computing system.
- BUT - even with language and program standardized, difficulty with graphics.
- Translation from BASIC to FORTRAN and vice versa.
- Put LAL on other systems.

Content

- some experiment-planning programs were dependent on a particular lab environment
- some teachers not willing to accept teaching methods of others.

2. With what success

- 6 programmes transferred within institutions in the first year of an NDPCAL multi-institutional project
- high, or good (2 comments)
- appreciable overall (2 comments)
- helps others get started.

U.K. Table 11 , Now own materials have been developed, to what extent are others used?

Within NDPCAL projects - 5

otherwise, almost none.

Most respondents have indicated in Table 10 that they perceive the use of their own materials by others as more satisfactory than their own use of others. This may be explained through referring to a later point in time. One use of other's materials cited was "to get started"; Table 11 indicates how narrow the range of exchange is once projects have their own materials. It can at least be said however that the NDPCAL is providing a context in which successful interchange of programs is taking place.

U.K. Tables 12 - 13 , Length and stability of establishment

12. Interaction

1. Projects predating NDPCAL

2

2. Interest predating NDPCAL	3
3. Collaboration with national programme as initiation of project	3

13. Life expectancy

1. Pilot projects with permanent establishment until 31 Dec. 77	7
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(cont.)

U.K. Tables 12-13 Length and stability of establishment (cont.)

2. Anticipate that projects will become assimilated and established	5
3. Some plans for future development	2

U.K. Tables 14 - 15 - 16 , Materials available and usage

	No of lessons	Subject (all tertiary)	Other computer materials	Regular instruction student terminal hrs/year
ESP Smith	42 - 12)	Chem. eng. nuclear, elec. mech. aero engineering	computer experiments	1000 2000
Ayscough	24	Chemistry (mainly physical chem.)		1600
Hartley	4 120 6 hrs 10 "	Chemistry Statistics Law Engineering design	generated materials (e.g. LOGO, number games, Educational Programming Langs, Interactive Calc. Facilities, Evaluation - (processes student records)	1000
McKenzie	30 each of 1 hr	Biology Chemistry Physics		
Jackson	30 each of 1 hr	Physics	problem solving tutorials	
Dunn	6 1 hr units 3 1 hr units 2 1 hr units	Emerg. simul. model Patient Manag. " Calculus Solid Geometry		
Leach		Maths		
Howe	not applicable (research, primary school maths)			500

U.K. Table 17 , Factors contributing most to success

Within the project group

	No of responses
Technical	1 - speed of response of computer system 1 - impact of computer graphics 1 - successful hardware
Organizational/ Socio	1 - opportunity to collaborate with other institutions 3 - enthusiasm, efficiency, hard work and commitment of team members 1 - modest aims 1 - perceived necessity of curriculum/instructional reform

Outside the project group

	1 - existence of the National Development Programme (but it was not essential - project would have gone ahead anyhow) 1 - favourable student response 1 - general pressure from departments being serviced 1 - publicity through papers and articles.
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II. PURPOSES OF THE PROJECT OR UNIT

U.K. II.1 Objectives

The reported objectives have been classified under the following headings, with the frequency of a response indicated where it (or a paraphrase) has been received from a number of projects.

1. Research
2. Educational
3. Financial
4. Technological
5. Implementation/Innovation Strategies.

1. Research

1. Artificial Intelligence - to develop a model of human learning based on the notion that human beings build schemata through contact with the environment; that these guide their actions; that the results of these actions are fed back through the senses; that schematas are confirmed/informed.
2. Research into learning and problem solving.
3. Research into the 'laboratory' use of the computer.

2. Educational

- overcome acknowledged difficulties of large 1st year classes and inadequate staff/student courses
- remedy situation of present student failure 'in service' courses
- enrichment of teaching and learning
- improvement of students' comprehension
- improvement of students' problem formulation
- students to construct and validate mathematical models
- identify decision-making models in clinical situations and develop these for teaching purposes.

3. Financial

- 2 - investigate comparable costs of CAL and existing courses and educational advantages

4. Technological

- 2 - feasibility of on-line graphics displays and the role of graphics terminals and other visual display units
- 2 - documentation and design of materials for ease of transferability
- 2 - determine the scale of the CAL operation and the nature of computer facility and support needed, included evaluation of own mini-computer with access to larger, commercial systems.

5. Implementation/Innovation development and strategies

- 2 - to secure widespread, institutionalised assimilation of CAL materials through
 - a. providing a service (a trained and experienced team) to identify, design, develop, write, implement, test CAL materials
 - b. produce tested learning packages, introduce into regular courses and also into new, integrated courses
 - c. spread involvement from committed to uncommitted staff members.
- 1 - provide teaching of CAI and associated disciplines (artificial intelligence, psychology of learning, problem solving).

There were few responses in the categories of research or cost-benefit.

Most projects responded with objectives in a number of categories, although one specialised project (Artificial Intelligence, Edinburgh) responded in only one (research).

Many of the objectives are expressed in the form of the nature of activities to be undertaken within a project rather than the goals that these activities were designed to achieve, and it is not always evident what these underlying goals may be.

The following tables indicate how the objectives expressed were arrived at, and how suggested underlying reasons for the development of computer based learning systems were ranked.

U.K. II, 2a How objectives were arrived at

- 3 - on the basis of a feasibility study, or more informally, on the basis of experience and judgment of likely developments
- 5 - collaborative discussion of interested parties, of which 4 specifically mention NDPCAL directorate.

U.K. II, 2b Which of the objectives reported are considered to be of most importance?

One project, reporting objectives in almost all of the categories above (including research) declined to indicate priority and indicated the interrelatedness of their objectives.

Educational objectives receiving priority

- 3 including - large student numbers in first year classes
 - problem solving skills
 - general enrichment

Implementation/Innovation/objectives receiving priority

- 2 - production, introduction of materials and the development of a trained team.

Technological/objectives receiving priority

- 3 including - establishment of soft-ware on mini computers
 - feasibility of on-line graphic displays
 - ease of transferability

U.K. II, 3 Rated importance of suggested reasons for developing computer based learning

Key :

High	rated	1-3
Medium	rated	4-6
Low	rated	7 or below, or not checked at all by projects responding to other suggested comments except where comment has been placed against an item indicating it was vague or ambiguous (2 occasions).

(cont.)

	high	medium	low	item too vague, or not understood
research on student learning	2	2	4	
individualisation of instruction	8	-	-	
mastery learning	3	2	2	1
evaluation of course elements	-	4	4	
effecting organisational change	-	-	8	
increasing capacity of educational provision	6	1	-	1
increasing teaching effectiveness	7	1	-	
decreasing students' learning time	-	2	6	
decreasing teachers' teaching time	-	2	6	
decreasing teachers' record keeping time	-	2	6	
other - effecting curriculum reform	2	-	-	

Comments

Increased effectiveness and capacity of educational provision are almost universally dominant goals. The most specific term - mastery learning - is ranked much lower than effectiveness.

All respondents perceive individualisation of instruction as a highly important underlying goal of computer-based learning. This is difficult to reconcile with the total rejection of organisational change. Individualisation of instruction must therefore be anticipated as occurring without concomitant organisational change.

There is little activity directed towards reduction of student's or teacher's time involvement in teaching and learning.

Only those projects directly involved in research rate it of high importance.

U.K. IV Training of non-specialists and consultancy services

1. Courses

	Yes	No	Not relevant
courses in author languages	1	2	4
courses in instructional design	1	5	2
advice and supervision for beginners	6	-	2

Additional responses

Smith describes procedures in the Engineering Science Projects as follows.

"The unit develops CAL packages to an initial specification which defines the mathematical model and broad teaching aims. Subsequent consultation between programmer and academic leads to program specification and development of the package. 30 academics involved."

Ayscough in Chemistry describes projected courses for Education Division of the Chemistry Society for 1976 and 1977. Workshops on instructional design, author languages with terminal practice.

Hartley at Leeds comments as follows:

"We used to consider that teachers should be able to develop and code materials, but now I do not believe that is the best use of their time.

Our efforts are now in having teachers

1. able to design the material
2. devise control programs and specify coding instructions
3. run laboratory, organise student data files and preliminary training of students
4. use and evaluate programs, inspect student records and thus integrate material with their own teaching.

These objectives are achieved through workshops."

(He does not report numbers involved to date)

Additionally, 4 projects report ad hoc demonstrations, occasional 1/2 day lecture demonstrations, informal discussion with project development officers.

Where projects report numbers of academics involved to date in workshops, these fall between 15 and 30 to date.

2. Further consultancy

Projects report as follows:

a. Problems of computer implementation

- back-up to be provided in transfer to other institutions

2 - advice always available from professional programmers/development officers within the project

(- advice is also available from outside the project through National Development Programme)

b. Problems of instructional design

4 - specialists within the project

1 - specialists from outside the project

c. Evaluation

3 - education officers within projects

3 - refer to the external evaluation within context of NDPCAL

2. Terminals

	Yes	Possibly	No	Comments
Paper	2	-	1	1 - always a need for a few
*) V.D.U. (Video Display Unit)	5	1	-	1 - if hard copy facilities become less expensive 3 - majority trend, with graphics capability 1 - more reliable
Plasma	-	3	1	1 - interesting 1 - too expensive
*) T.V.	3	-	-	1 - graphical display vital in science and engineering 1 - compatible terminals simplify the use of CAL in lectures 1 - for dynamic displays only

3. Systems software

	Yes	Possibly	No	Comments
Standard languages	4	1	-	- for short term, FORTRAN, BASIC - will depend on availability - the higher level the better
CAI languages	-	1	3	- no good unless transferable - not for simulation - better CAI languages required, implemented in high level languages to get more power, friendlier syntax etc.
Mixed development	4	-	-	- we have felt the need for both CAI and standard languages - plus home-grown CAL-data structures

Further comment - 'transferability requires a language available on MANY systems, large or small.'

*) VDU and TV were separately categorised for the following reason:
A major goal of many working in computer assisted instruction is off-campus, home-based learning. A domestic TV-set having as few modifications as possible for CAI use would be an appropriate terminal.

4. Style

	Yes	Possibly	No	Comments
Test-adminis- tration	5	-	-	2 - but this isn't CAL!
Drill and practice	4	-	-	- some - yes, least important, though
Simple techniques	5	-	-	
Complex learning	6	1	1	- this will be increasingly possible as graphics terminals become more sophisticated and cheaper - most important

2 Projects cancelled headings and reclassified styles, and
1 other project added supplementary comments to indicate the
following modes:

2 - tutorial (= test/teach and practice)

3 - simulation/laboratory mode

1 - educational use of computer languages such as LOGO, APL

All projects gave multiple responses, indicating expected
mixed development.

5. Development

	Yes	Possibly	No	Comments
individual	3	-	-	- initiative will probably continue to come from individuals
team	7	1	-	3 - academic + programmer plus CAL expert 2 - as above + educational evaluator 1 - as above + different institutions 1 - it is essential that the academic who is to use the material should be involved in the development
commercial company	-	-	3	- not at university level

6. Interchange

Where?

- 5 - between institutes with similar teaching aims, compatible level, such as in U.K. under National Development Program
- 1 - this is difficult, because educational problems are at least as difficult as computing problems.

How?

- 1 - collaboration of small groups of teachers from earliest stages of packet development
- 1 - by individual contact backed by conferences and seminars etc.
- 4 - - through a national clearing house
 - there is an urgent need to consider the establishment of CAL exchange. Facilities/studies are in hand / further studies commissioned by National Program Directorate.

U.K. VI Commitment and further free comments

- 4 respondents indicated serious, close, even total involvement with the future development of computer based learning.
- 2 of these indicated some uncertainty about source and level of support in 1978 and after (after NDPCAL).

1. Decision Basis for Topic Selection

a. Who decides?

2	Project Director + academics/teachers
3	Project Steering Committee
2	Project staff
3	Practising teachers

(one double entry because for one project,
steering committee not always involved)

b. Criteria?

- 3 - current syllabus, existing presentation
poorly understood by students and
 - student numbers largeand/or - course frequently taught
and/or - course of widespread interest
- 2 - likelihood of transfer
- 2 - conformity to instructional prototypes
favoured within the project and considered
amenable to computer presentation,

Dunn, Glasgow - "recognition of decision-making
models in clinical situations"

Smith, Engineering Sciences Project -
"Topics related to models whose responses
can be determined only by computer.
May be by virtue of

- 1. complexity of defining equations
- 2. requirement for numerical techniques
- 3. " " repetitive or
recursive evaluation.

2. Who constructs the packages?

All 9 projects responded in the affirmative to combination of
teachers and specialists in computer assisted learning.

Most projects gave multiple responses.

	Yes	Occasionally
1. teachers plus specialists	9	-
2. teachers alone	1	3
3. teachers plus students	2	4

Of the 'specialists' in 1., 2 projects specified education specialists. Most specified computer/CAI specialists.

3. Who sets the package in courseware?

All projects responded that those who constructed the packages also did this, so that answers correspond to question 2. above.

4. Who evaluates the courseware developed?

(There are some multiple entries)

1. Who?

External (UNCAL, University Education Dept)	3
Specialist assistants within the project	4
Teachers and project staff who developed the package	5

2. How? (there are some multiple entries)

Records of student responses and other program events maintained by software	4
Students complete short questionnaire recording their attitudes	4
Students interviewed	4
Subjective evaluation by project staff	2

3. With what results?

- 4 projects specifically report that software records are used to improve the packages, improve understanding of the problems
- 1 project indicates the importance of the evaluation of packages in securing funding for the extension of the project.

All projects except one also add 'satisfactory', or 'generally favourable' as a subjective comment.

U.K. V2: Expectations of computer based learning

1. Configuration (Some multiple responses with comparative comments)

	Number of responses	Comments
1. Big stand-alone (CAI dedicated or mixed)	3	2 - certainly not mixed 1 - time shared terminals for low volume (< 500 hrs/yr)
2. Stand-alone dedicated mini (or micro)	5	2 - preferred for 'laboratory' applications 1 - may be solution if file space adequate (∴ not small minis) 2 - stand-alone dedicated medium computers, used interactively, sometimes with link to larger computer for batch processing or complicated parts of program
3. Computers in networks	4 (all of which also check (2) as possible alternative)	1 - may be best longterm solution, with small local computer presenting material drawn from large central file 1 - network development preferable if the expertise is available, otherwise micro

- Further comments
- 'Impossible to say, but must be dedicated'.
 - 'We expect centralisation of systems, either by systems or networked minis.'
 - 'Midi computers supporting a few CAL applications in geographically close areas.'